

**COLORADO RIVER RECOVERY PROGRAM  
FY-2001 PROPOSED SCOPE OF WORK**

Project #: CAP-4b  
Redlands Fish Passage Evaluation

Lead Agency: Fish and Wildlife Service  
Colorado River Fishery Project

Submitted by: Frank K. Pfeifer, Project Leader  
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Category:

- ☒ Ongoing project
- ☐ Ongoing-revised project
- ☐ Requested new project
- ☐ Unsolicited proposal

Expected Funding Source:

- ☒ Annual funds
- ☐ Capital funds
- ☒ Other (explain)

I. Title of Proposal: **a. Evaluation of the Effectiveness of the Fish Passage Structure at the Redlands Diversion Dam and b. Movement of Sub-adult and Adult Colorado Pikeminnow Following Passage Through the Redlands Fishway and Identification of Colorado Pikeminnow Spawning Sites in the Gunnison River** (added in 1998)

II. Relationship to RIPRAP: Colorado River Action Plan: Gunnison River: II.B.1.d. Monitor and evaluate success [of the fish passage structure at the Redlands Diversion Dam] V.A.2. Conduct research to acquire life history information and enhance scientific techniques required to complete recovery actions: Identify additional spawning sites of endangered fishes in the Gunnison River (added on for 1998).

III. Study Background/Rationale and Hypotheses:

Blockage of Colorado pikeminnow movement by dams and water diversion structures has been suggested as an important cause of the decline of this species in the Upper Colorado River Basin (Tyus 1984; Burdick and Kaeding 1990). Although the actual role that blockage might have contributed in the decline of these species in the upper basin is unknown, providing fish passage past instream barriers has come to be considered an important means to aid the recovery of this species.

The Redlands Diversion Dam, constructed in 1918, is a 12-foot high irrigation structure

that has effectively restricted upstream movement of fishes from the Colorado and lower Gunnison rivers to the upper Gunnison River. The Gunnison River upstream of the Redlands Diversion Dam is historic habitat for both Colorado pikeminnow and razorback sucker. A small enclave population of juvenile and adult Colorado pikeminnow presently exists upstream of Redlands. The last documented capture of a wild razorback sucker in the Gunnison River upstream of Redlands Diversion Dam was in 1981 (Holden et al. 1981). Twenty-one adult razorback sucker were stocked in April 1994 and another four adults were stocked in the fall of 1995. Three-hundred sixteen juvenile razorback sucker were stocked October 1995 and 287, 9 to 16-inch sub-adult razorback sucker were stocked in October 1996. In 1997, 3,732, 5- to 15-inch juvenile and sub-adult razorback sucker were stocked in the Gunnison River at river mile 57 on nine different dates from three different sources between 12 September and 14 October. In 1998, 608, 3 to 19-inch pond-reared razorback sucker were stocked in the Gunnison River at river mile 57 on three different dates between 23 June and 29 October.

Hypothetically, reduction of the historical population of Colorado pikeminnow in the river reach upstream of Redlands Diversion Dam may be explained by instream barriers that have served to effectively block adult fish during seasonal movements, especially spawning migrations. If spawning occurred downstream of Redlands Diversion Dam, the upstream stock would have been rapidly depleted of adults migrating downstream and over the diversion dam to spawn. On the other hand, if spawning occurred upstream of Redlands Diversion Dam, larval drift would likely place young-of-the-year fish downstream of the diversion dam and effectively block recruitment to the adult population. Over time, the upstream populations would diminish through attrition of adults and lack of recruitment.

The collection of larval Colorado pikeminnow in 1994, 1995, and 1996 upstream of the Redlands Dam indicates that Colorado pikeminnow spawn in the Gunnison River upstream of the dam. The fact that larval Colorado pikeminnow were collected in each of these three years at Bridgeport (RM 29.3) is not only evidence that they did spawn, but reproduction occurred somewhere upstream. The congregation of adult radiotagged pikeminnow in the same location (RM 32-33) for two years in a row during the estimated spawning period (Burdick 1995) plus the collection of larvae 4 miles downstream at Bridgeport suggests that Colorado pikeminnow were spawning at that location. Larval Colorado pikeminnow have been collected both up- and downstream of the Redlands Diversion Dam. One larval Colorado pikeminnow was collected immediately downstream of the Redlands Diversion Dam in August 1986 (Osmundson and Kaeding 1989). Two other larval Colorado pikeminnow were collected in this reach in 1992 (Anderson 1994). One larvae was found in 1994 at Bridgeport. Six larval Colorado pikeminnow were collected in 1995 and eight in 1996 (Anderson 1999). In 1995, five were captured upstream of Redlands, two at RM 5.2 and three at RM 29.3. The one downstream specimen was collected at RM 2.6. In 1996, one was captured at RM 29.3, four at RM 5.2, and three at RM 2.6.

The fish passageway at Redlands Diversion Dam was designed and constructed to pass

both juvenile and adult Colorado pikeminnow and razorback sucker. Construction of the fish passageway at the Redlands Diversion Dam was completed in June 1996 and become operational 24 June. The fish passageway was a joint effort of the U. S. Bureau of Reclamation (BR) with biological and technical guidance from the U. S. Fish and Wildlife Service (Service), the State of Colorado, and Redlands Water and Power Company. The fish passageway is routinely opened in March and is winterized in late-October or early-November.

The overall goal is to evaluate whether sub-adult and adult Colorado pikeminnow and razorback sucker will use this passageway. This passageway was constructed as an experimental facility to determine the utility of using fish passage as a recovery tool for these species at other instream barriers in the Upper Colorado River Basin. Specific objectives are to determine 1) the use of the fish passageway seasonally by all native and nonnative fishes and 2) the extent of movement of sub-adult and adult Colorado pikeminnow in the fish passageway, in the plunge pool, and in the 2.3-mile reach downstream of the diversion dam using radiotelemetry.

The fish passageway will extend the range of these two native fishes upstream about 50 miles into historical habitat and may allow Colorado pikeminnow to naturally re-colonize these upstream reaches. The Gunnison River, upstream of the Redlands Diversion Dam, supports a predominantly native fish community (79%), primarily juvenile and adult bluehead sucker, flannelmouth sucker, roundtail chub, and speckled dace (Burdick 1995). These native fish, historically preferred prey of the piscivorous Colorado pikeminnow, would provide a substantial food source.

A fish trapping facility located at the upper end or forebay of the fishway allows researchers to sort, examine, and count fish and remove nonnative fish from the system. The 350-foot long fishway has 49 individual baffles that can be removed for cleaning or adjusted to experiment with various flow configurations.

From both direct capture data and from radiotelemetry contacts, a considerable database exists that indicate both juvenile and adult Colorado pikeminnow use the plunge pool and the downstream reach. In the Upper Colorado River, the numbers of razorback sucker encountered are considerably less than that of Colorado pikeminnow and are now extremely rare. Stocking razorback sucker will most likely have to be conducted to re-establish them to historical stream reaches.

Initially, there were several uncertainties regarding whether Colorado pikeminnow or razorback sucker would use the fishway because it was the first such passageway to be constructed to pass these species. In four years of operation, a total of 47 sub-adult and adult Colorado pikeminnow have used the fishway—almost exclusively in July and August. No razorback sucker have been found in the fish trap.

Construction of the fish passageway at Redlands is viewed as a long-term commitment that will require biological monitoring over several years. An ongoing, comprehensive

monitoring program started in June 1996 will continue for five years through October 2000.

#### Field Summary Results to Date (1996-1997)

##### 1996

Only one adult Colorado pikeminnow was collected in the fish trap at the upstream end of the fish passageway. This pikeminnow ascended the fish ladder on 28 August 1996 and was released upstream of the dam. A total of 8,368 fish were counted and fin-clipped in the fish trap from 24 June to 25 October. Five native and 11 nonnative species plus three hybrid sucker fishes were collected in the fish trap. Ninety-four percent of the fish collected were natives. Bluehead sucker comprised 45% of the catch, flannemouth sucker, 42%. White sucker comprised the largest number of nonnative fish (2%).

Native fish fin-clipped and released upstream of Redlands Diversion Dam dispersed upstream, some as far as 57 river miles to the base of Hartland Diversion Dam. Of 7,187 flannemouth sucker, bluehead sucker, and roundtail chub fin-clipped and released upstream of the Redlands Diversion Dam between 24 June and 6 September 1996, 55 flannemouth sucker, 46 bluehead sucker, and three roundtail chub were recaptured in September and October upstream of the dam. This accounted for 1.9%, 1.2%, and 0.7% of the total number of each species fin-clipped at the dam, respectively, during 1996.

Of the eleven adult Colorado pikeminnow that were implanted with 360-day LOTEK® radiotags during May and June, none used the fish passageway. One land-based tracking station located at the dam and two located downstream in the 2.3-mile reach of the Lower Gunnison River constantly monitored and logged any movement of radiotagged fish in the vicinity. Four radiotagged fish occupied the plunge pool of the Redlands Diversion Dam intermittently between 17 June and 16 October.

##### 1997

In 1997, eighteen sub-adult and adult Colorado pikeminnow (total length range=383-763; mean=537 mm) ascended the fish passageway compared to only one adult Colorado pikeminnow that was collected in the fish trap in 1996. None of these fish were radiotagged. In 1997, four pikeminnow used the fish passageway in July and 14 in August. Three of these fish had been captured previously from the Colorado River downstream of Moab, Utah. In 1996, the one adult pikeminnow that used the fish passageway also ascended the ladder during August. All pikeminnow were released upstream of the dam. Following release, it is unknown whether the fish continued upstream or fell back over the Redlands Diversion Dam (RM 3).

In 1997, a total of 12,235 fish comprising six native and eight nonnative species plus three hybrid sucker fishes were collected in the fish trap. Ninety-four percent of the fish collected were natives. Flannemouth sucker comprised 43% of the catch, bluehead

sucker, 41%. White sucker comprised the largest number of nonnative fish (2%).

Of the 12 adult Colorado pikeminnow that were implanted with 360-day LOTEK® radiotags during April, May, and June 1997, none used the fish passageway. None of the pikeminnow implanted with radiotags in 1996 used the passageway in 1996 or 1997. One fixed, land-based tracking station located at the dam and two located downstream in the 2.3-mile reach of the Lower Gunnison River constantly monitored and logged any movement of radiotagged fish in the vicinity. Following radiotag implantation in 1997, only two radiotagged fish were detected about 0.1-mile downstream of the Redlands Diversion Dam plunge pool intermittently during mid-July and mid-September. Two other radiotagged fish were detected occupying a lower section of the 2.3-mile reach of the Lower Gunnison River intermittently during mid-July and mid-September. Unfortunately, the radiotag of one Colorado pikeminnow implanted in June 1997 was recovered in Walter Walker State Wildlife Area in August.

### 1998

Twenty-three sub-adult and adult Colorado pikeminnow (total length range=415-696; mean=516 mm) ascended the fish passageway in July and August compared to one in 1996 and 18 in 1997. Two pikeminnow found in the fish trap in 1997 were again found in the trap in 1998. Another pikeminnow that used the fish ladder in 1997 and released upstream of the diversion dam, sometime moved over the diversion dam following its release because it was recaptured in a trap net at 29-5/8 Road pond on the Colorado River in May 1998. Three of the four pikeminnow radiotagged and translocated upstream of the Redlands Diversion Dam moved downstream following release over the diversion dam sometime in late-June, just prior to the suspected spawning season. A total of 7,598 fish were collected in the fish trap in 1998. Ninety-three percent were native fishes, including 55% bluehead sucker and 30% flannelmouth suckers.

### 1999

In 1999, five sub-adult and adult Colorado pikeminnow were collected in the fish trap--four of these were implanted with LOTEK® radio transmitters and released upstream of the dam. Eight-thousand, two-hundred sixty-four fish were collected in the fish trap in 1999. Ninety-three percent were native fishes, including 54% bluehead sucker and 29% flannelmouth suckers.

### Summary

To date, 47 sub-adult and adult Colorado pikeminnow have been collected in the fish trap. Pikeminnow have used the ladder almost exclusively in July and August over the past four years: 13 in July and 33 in August. However, in 1999, one pikeminnow was found in the fish trap in September. Five different pikeminnow have ascended the fish passageway twice; one of these pikeminnow has ascended the fish passageway three different times. None of these fish that reascended the passageway did so the same year.

Interestingly, the one pikeminnow that has ascended the fish passageway three times did so between the 3rd and 6th of August during 1997, 1998, and 1999. Since its completion in 1996, approximately 36,450 fish have used the fishway. Native fishes have comprised about 93% of this total in each of these 4 years. None of the 23 pikeminnow radiotagged in 1996 and 1997 have used the fish passageway. Two of the four Colorado pikeminnow that were implanted with radiotags following capture in the fish trap in 1999 and subsequently released upstream of the Redlands Dam passed over the dam. One of these fish spent 26 days upstream of the dam whereas the other fish was located 19 miles downstream in the Colorado River near Fruita (river mile 156.5) in mid-February 2000 by boat. As mentioned previously, three of the four pikeminnow radiotagged and translocated upstream of the dam in spring 1998 moved downstream following release over the diversion dam sometime in late-June of the same year, just prior to the suspected spawning season.

Native fishes that used the passageway and that were marked in 1996 dispersed upstream, some as far as Hartland Diversion Dam 57 miles upstream of Redlands Diversion Dam; others, including at least six pikeminnow, released immediately upstream of the diversion dam have fallen back over the dam. Some of these fish, including five pikeminnow, have reascended the fish passageway as they have been captured again in the fish trap. The fish passageway has provided a means by which native fish populations downstream of the diversion dam can now re-colonize and re-populate stream reaches upstream of the dam in the Gunnison River, reconnecting fish populations between the Upper Colorado and Gunnison rivers. Providing passage at Redlands Diversion Dam has potentially extended the range of native fishes upstream about 50 miles into historical habitat and has allowed Colorado pikeminnow to naturally re-occupy upstream warmwater reaches in the Gunnison River. This demonstrates that fish populations in the Colorado and Gunnison rivers are no longer physically isolated.

#### IV. Study Goals, Objectives, End Product:

##### Study Goals

Evaluate whether juvenile and adult Colorado pikeminnow will use a passageway.

##### Objectives

1. Determine the use of the fish passageway by juvenile and adult native and nonnative fishes, with particular emphasis on Colorado pikeminnow.
2. Determine the extent of movement of juvenile and adult Colorado pikeminnow in the fish passageway, in the Redlands Diversion Dam plunge pool, and in the 2.3-mile reach downstream of the diversion dam using radiotelemetry technology.
3. Determine the utility of using fish passage as a recovery tool for these species at other instream barriers.

4. Determine the "threshold" or minimum flow when Colorado pikeminnow vacate the plunge pool and 2.3-mile reach using radiotelemetry and direct observation.

Evaluate movements and distribution of Colorado pikeminnow that pass through the Redlands fish passageway.

#### Objectives

1. Determine movement patterns and distribution of sub-adult and adult Colorado pikeminnow that pass through the Redlands fish passageway that are released immediately upstream of the Redlands Diversion Dam.
2. Identify any Colorado pikeminnow congregations that may be related to the spawning period in the Gunnison River.
3. Determine if any of the Colorado pikeminnow that have passed through the Redlands fish passageway are associated with other Colorado pikeminnow at spawning site(s) in the Gunnison River.

#### End Products

1. Definitive data on passage--number of species; numbers per species; seasonal use and distribution by species.
  2. Data on temporal and spatial movement and distribution of radiotagged Colorado pikeminnow relative to the fish passageway--within and near the fish passageway, in the plunge pool, and in the 2.3-mile reach.
  3. Recommendations as to whether to pursue fish passage at other instream barriers or if modifications are needed at Redlands.
  4. Identification of new or verification of spawning areas formerly identified for Colorado pikeminnow in the Gunnison River upstream of Redlands Diversion Dam (added on for 1998).
- V. Study area: Gunnison River: river mile 0.7-3.0 (confluence of the Colorado River upstream to the Redlands Diversion Dam), upstream of the Redlands Diversion Dam (river mile 3.1-60.0); Colorado River: 15- and 18-mile stream reaches.
- VI. Study Methods/Approach:

A trapping facility constructed at the upstream end of the fish passageway structure designed to collect fish has been routinely monitored daily, Monday through Friday. Trash is usually removed from the trash grates once on the weekends when the fishway is being operated. The fish trap has not been operated between early-November and March

in each of the four years of operation.

The trapping facility has allowed researchers to assess the use of the passage structure by all fish species. All fishes that have been collected have been sorted, examined, and counted. Nonnative fish (except salmonids) have been removed from the river. Colorado pikeminnow and any razorback sucker collected in the trap have been checked for a PIT tag or PIT tagged if they have not been previously marked. None of the pikeminnow captured in the fish trap have previously been radiotagged. Crews checking the fish trap are also responsible for 1) periodic cleaning of riverborne sediment in the fish trap that usually builds up during runoff, and 2) routine (daily) cleaning of surface and submerged trash, debris, and riverborne algae from the trash racks and bar screens in the forebay of the fish passageway, and aluminum conduit screens in the fish trap. The amount of algae, debris, trash, and sediment that accumulates daily at this site is seasonally variable, depending upon flow magnitude and water volume during the water year.

Radiotelemetry technology has been used to determine if Colorado pikeminnow have used the fish passageway and to monitor the temporal and spatial movements of juvenile and adult Colorado pikeminnow within the passageway, in the plunge pool immediately downstream of the dam, 15- and 18-mile reaches of the Upper Colorado River, and the Gunnison River from the confluence with the Colorado River upstream to RM 34. A state-of-the-art automatic pulse-coded, digital data-logging radiotelemetry tracking system (LOTEK® 1995) has been used that constantly monitors the movements and distribution of radiotagged fish. This system provides an automatic means of constantly and simultaneously monitoring and storing unique codes of tagged fish in addition to logging the date, time, frequency, signal strength, and providing fish position relative to a particular antenna. To accomplish this objective, radio transmitters were implanted in 11 sub-adult and adult Colorado pikeminnow in 1996 and 12 in 1997. In 1998, four fish were captured from the lower 2.3-mile reach of the Gunnison River, translocated upstream of the Redlands Diversion Dam, and released at Whitewater (RM 15) and Bridgeport. Fish that had shown an affinity for the lower Gunnison River were given priority. In 1996 and 1997, fish from the plunge pool and from the 2.3-mile reach were captured for radio-tag implantation. Since not enough fish could be captured from the Lower Gunnison River, fish from stream reaches in the Colorado River up- and downstream from the Gunnison River confluence were implanted with radiotags, translocated to the Lower Gunnison River and released immediately downstream of the Redlands Diversion Dam both in 1996 and 1997. Antennae deployed in the fishway entrance, at two different locations within the fishway (mid-way and top), immediately up- and downstream of the fishway, and at two locations downstream of the fish passageway (at about river mile 2.4 and 1.4) detected the location of radiotagged Colorado pikeminnow.

Colorado pikeminnow that successfully negotiated the fishway and that were captured in the fish trap were placed upstream of the fish passageway. Pikeminnow with active radiotags were tracked manually by boat. Searches for radiotagged fish included the 15-



and 18-mile reaches of the Colorado River, the 2.3-mile reach of the Lower Gunnison River downstream of the diversion dam to the confluence with the Colorado River, and the Gunnison River upstream of the diversion dam to Whitewater.

#### 1999 and 2000 Work (continuation of work added in 1998)

The fate of Colorado pikeminnow that are captured in the Redlands passageway fish trap and subsequently released immediately upstream of the Redlands Diversion Dam is unknown. Information is needed to determine if released pikeminnow continue upstream in the Gunnison River or fall back over the diversion dam, the distance they disperse upstream, and duration they might remain upstream. Also, if these fish remain upstream, will they congregate during the suspected spawning season or will they return downstream over the diversion dam and return to the Colorado River?

Four sub-adult and adult Colorado pikeminnow captured in the Redlands passageway fish trap in 1999 were implanted with LOTEK® radio transmitters (10-gram weight with a 550-day life expectancy). These fish were released immediately upstream of the Redlands Diversion Dam. The movements of these tagged fish were tracked by three automated land-based tracking stations strategically located in the Gunnison River and from boats between and outside fixed-station sites in the fall of 1999 and winter of 2000. Boat searches for radiotagged fish included the 15- and 18-mile reaches of the Colorado River, Loma to the Utah/Colorado Stateline on the Colorado River, and the Gunnison River upstream to river mile 34. A semi-permanent, fixed land-based tracking station located at the Redlands Diversion Dam helped verify when radiotagged fish passed over the dam. One land-based station was deployed near Whitewater (river mile 15.3) and one further upstream at river mile 33.7 in 1999. Monitoring the movements of these radiotagged fish will continue through the spring and summer of 2000.

If radiotagged fish congregate near spawning time, intensive sampling of the area with trammel nets and electrofishing will be conducted to capture other pikeminnow to determine reproductive condition and also to determine if any of the fish that have passed through the Redlands fish passageway are associating with spawning fish.

Electrofishing surveys of the Gunnison River to assess stocked razorback sucker dispersal and survival will be conducted in FY2001 from Delta to Redlands Diversion Dam. Attempts to capture Colorado pikeminnow released upstream of the dam will be conducted concurrent with this effort. Two electrofishing craft will systematically sample the river downstream.

## VII. Task Description and Schedule

### Description

Task 1. Radiotag sub-adult and adult Colorado pikeminnow caught in the Redlands Diversion Dam passageway fish trap.

- Task 2. Deploy automatic radiotelemetry system, monitor movements of radiotagged fish, download and operate radiotelemetry system.
- Task 3. Routine O & M of the fish ladder and fish trap which includes monitoring the fish trap, sorting, examining, and enumerating all fish in addition to cleaning trash and debris from the trash racks, bar screens, fish trap, and fishway entrance.
- Task 4. Analyze and evaluate data; prepare annual progress report.
- Task 5. Prepare draft and final report.

#### Schedule

- Task 1. 4/98→6/15/98; 4/99→6/15/99; 7/99→9/99
- Task 2. 10/96→9/97; 10/97→9/98; 10/98→9/99; 10/99→9/2000
- Task 3. 6/96→9/96; 3/97→10/97; 3/98→10/98; 3/99→10/99; 3/2000→10/2000; 3/2001→10/2001
- Task 4. 10/96→12/96; 10/97→12/97; 10/98→12/98; 10/99→12/99
- Task 5. 1/2000→1/2001

#### VIII. FY-2001 Work

Deliverables/Due Dates: routine O & M of the fish passageway and fishtrap: monitor fish trap; sort, examine, and enumerate all fish; analyze and evaluate data; prepare and submit draft and final report. Final draft report due 31 January 2001.

#### Budget Estimate

##### Tasks

##### Labor

Fish Ladder O & M \$ 24,000

Final Report Preparation \$ 9,000

Total \$ 33,000

Task 3. \$24,000 (O&M plus 10% overhead)

Task 5. \$ 9,000 (Annual funds plus 10% overhead)

Total \$33,000 (Plus 10% overhead)

IX. Budget Summary

	<u>Project Cost</u>
FY-2001	\$ 33,000
Grand Total:	\$ 33,000 (Plus 10% overhead)

X. Reviewers:

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XI. References

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